MOUNTING AND PRESERVING NEUROPTERA FOR SCIENTIFIC STUDY[1,2]

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ABSTRACT: Proper techniques for mounting and preserving adult specimens of Neuroptera are described. All neuropterans should be pinned or pointed except the Coniopterygidae, which are best preserved in alcohol. Summaries of special mounting practices for each family are provided. Procedures for preparing genitalia for study are also discussed.

Authors of publications dedicated to proper techniques for mounting and preserving insects have generally assigned methods of preservation to groups of insects based on body size and structure without regard to important taxonomic characters of individual families. Generalizations within certain orders such as Neuroptera, with its widely varied forms, have proved unsatisfactory and usually vary with authors. Consequently, specimens of a single taxon within a large collection may be preserved in a variety of ways due to confusion or disagreement of collectors as to the best techniques.

Members of each family possess certain characters important for their determinations to species. Any specimen should be preserved to: 1) best retain and allow examination of important characters with a minimum of future manipulation; 2) reduce the likelihood of breakage; and 3) facilitate incorporation into a large permanent collection for future study. The best techniques often require a compromise of these considerations.

This paper deals specifically with the best methods for mounting and preserving Nearctic species of Neuroptera. There seldom is unanimous agreement as to which methods should be employed. This paper is a compilation of ideas with the purpose of identifying inferior practices, suggesting which techniques are superior and providing alternatives when no consensus exists.

METHODS AND MATERIALS

The fact that most Neuroptera tend either to shrivel or discolor when dried has prompted many collectors to opt for alcoholic preservation of specimens. One advantage of alcohol is that specimens remain soft and

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flexible, thus reducing breakage problems associated with fragile insects such as neuropterans. Another advantage is that broken parts remain associated with the specimen. Generally, however, dried specimens retain all important taxonomic characters and usually require less trouble to maintain than those in alcohol. Most neuropterists find it easier to work with pinned material. Even liquid-preserved specimens are often difficult to manipulate and wing tearing or antennal breakage can result. In addition, coloration nearly always fades in alcohol (for example, Chrysopidae), although color usually is of limited importance in taxonomic studies. Occasionally, neuropterists will retain a few specimens of certain groups in alcohol when collecting a series, but pinning (or pointing) remains the general preference.

Some collectors use glassine envelopes for storing larger forms such as ascalaphids or myrmeleontids. Envelopes allow more compact storage and help keep broken parts from being lost without the disadvantage of fading caused by alcohol; however, they are not recommended except for temporary storage before spreading. Specimens so preserved are often difficult to examine and breakage is frequently a problem. The fact that alcohol, envelope, and pinned collections must be maintained separately is inconvenient. In the interest of standarization, pinning or pointing neuropterans should be the general rule with the exception of the Coniopterygidae. The latter should be stored in alcohol.

Materials needed for mounting and preserving Neuroptera are basically simple. For a detailed treatment of general collecting and mounting techniques, see Martin (1977). There is disagreement regarding which sizes of pins to use. Most neuropterists use sizes no. 1 to 3; however, some prefer the use of size 0 to 00 pins for more delicate forms in order to reduce damage to the thorax and the need for double-mounting or pointing. The main disadvantages of thin pins are: they are only practical for foam pinning surfaces; they tend to bend easily; and their springing action, if flipped, can cause destruction of the specimen. For these reasons, and the fact that characters of the mesothorax are seldom important, I do not recommend specimens be pinned directly with anything smaller than a no. 1. A good rule is to use the largest pin that will not cause damage to the specimen.

For small specimens that are too delicate to be pinned, there are two alternatives: double-mounting and pointing. Double mounting, using a minuten pin through a strip of polyporous material (pith), is preferred. When pointing, the right side of the specimen is glued to the paper point which has been bent at the tip. The disadvantage of this technique is that specimens often break loose and become damaged, lost or cannot be associated with proper labels. One should use a sufficient amount of glue for a good bond and affix the point to the thorax of the specimen rather than to the wing. Specimens bonded at the wing alone tear loose more frequently

leaving only the forewing attached.

A styrofoam block is useful for support during drying, or a grooved spreading board is useful when the spreading of wings is desired. Specimens can also be dried in a box placed in the vertical position. This eliminates the need for support and allows the abdomens to dry parallel to the pinning bottom.

A few general rules should be followed when mounting Neuroptera. It is preferable to pin freshly collected material. Relaxing dried neuropterans should be avoided, when possible, to prevent wings from sticking together and loss of color. When mounting, care should be taken that wings and antennae do not dry in a position where they might be broken by subsequent handling of the specimen. Bending the head and antenna downward before drying, and the use of pins securing the wings will prevent this. It is also important not to allow the wings to dry in a position too close to the abdomen so that removal of terminal abdominal segments is difficult.

Special Instructions

The Hemerobiidae are usually too small to be pinned directly with anything except the smallest size pins. It is recommended that they be double-mounted. Because examination of external male genitalia is sufficient to determine most species, it is desirable to pull out at least one pair of wings to allow a better view of the abdomen. This procedure also allows examination of hindwing characters which sometimes aid in determinations. It can be easily accomplished by pulling out the wings individually with a pin beneath the wing and securing them in place as illustrated in Fig. 1. A spreading board can also be used for drying the wings flat. Double-mounting should be done before embedding the minuten in the strip. When using paper points, allow the glue to set with the specimen supported on a block of styrofoam, then pull the left pair of wings away from the body and secure with pins. If spreading the wings flat is desired, this can be done in a grooved board after the glue dries. If the specimen dies with the wings in an upstroke position, some manipulation of the wings may be necessary in order to allow forewing characters to be seen.

Most Chrysopidae are large enough to be pinned directly with no. 1 pins. Because wings are transparent, it is seldom necessary that they be spread, but it may be advantageous for several specimens of a series or for uncommon species. Wing venation is used extensively as a taxonomic character at the generic level, but male genitalia, which are primarily internal, are the most important for specific (and some generic) determinations. Markings of the head and body are also used to a great degree but variation can make them unreliable characters.

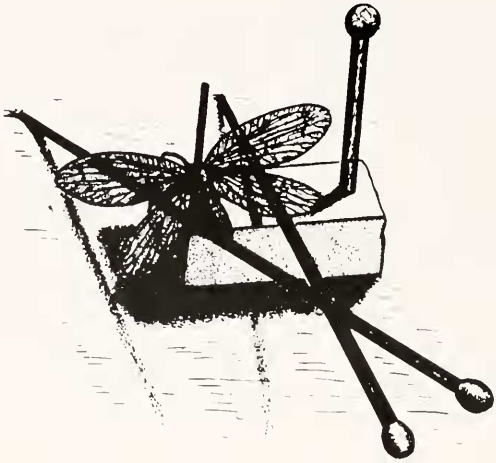

Fig. 1. Double-mounted hemerobiid.

If preserving chrysopids in alcohol is necessary, it should be noted that color markings, especially reds and oranges, often fade completely and some dark veins in the wing may become pale. This can cause confusion when attempting determinations.

It should be noted that chrysopid genitalia do not fully develop and sclerotize until a few days after emergence. For this reason, it may be wise to hold live specimens for a few days if genitalic examinations are desired. This is essential for reared material.

The Sisyridae are small and should always be double-mounted or pointed. The few North American species of this family can be separated by characters of the forewing. Still, genitalia of both sexes are usually diagnostic so it is suggested these insects be mounted like Hemerobiidae (wings partially spread).

The Mantisipidae are usually large enough to be pinned directly. The wings may be spread if desired, but wing venation is seldom used for determinations. Mantisipid taxonomy is in need of revision, thus important diagnostic characters have not been identified in some cases. Color patterns are important in determining Mantispinae (Redborg 1982), while male genitalia are used in Platymantispinae (Rehn 1939). The only special mounting consideration might be to spread the forelegs so that setal patterns are easily seen.

The Myrmeleontidae are among the largest Neuroptera and can create spatial problems if wings are fully spread. Stange (1970) prefers pining antlions with wings held rooflike over the body and recommends against use of

a stabilizing pin to prevent loss of the abdomen. I have found that spreading the right pair of wings slightly out from the body (Fig. 2) allows easier examination of the important hindwing without sacrificing much additional space. This can be done with a grooved spreading board, a block of styrofoam or by the use of pins in a box. Some workers prefer the right pair of wings spread at right angles, primarily for aesthetic reasons.

The Ascalaphidae are the most robust Neuroptera and no. 3 pins can always be used. As with ant-lions, specimens require more space in collections if wings are spread. Moreover, their long antennae are easily broken if left to dry while extended away from the body, thus, wings should be held over the body and antennae pulled back as in Fig. 3. This practice can reduce space requirements by about one-half. The six recognized Neartic species can usually be separated without difficulty and the visibility of characters is not a problem in this group.

The Coniopterygidae is the only group best preserved in alohol. Pinned material is much more difficult to determine and removal of terminalia for genitalic examination is always required. In alcohol, the characteristic whitish coat of wax covering the insect is lost, but this proves to be an

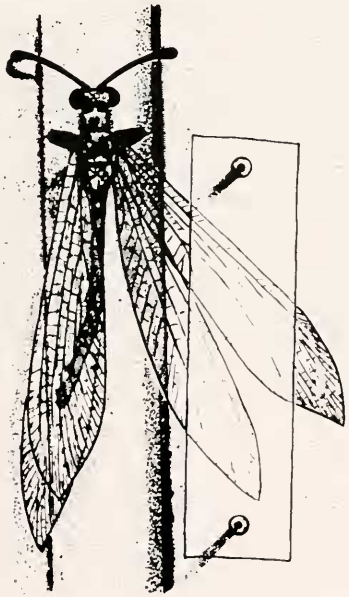

Fig. 2. Suggested method of mounting myrmeleontids.

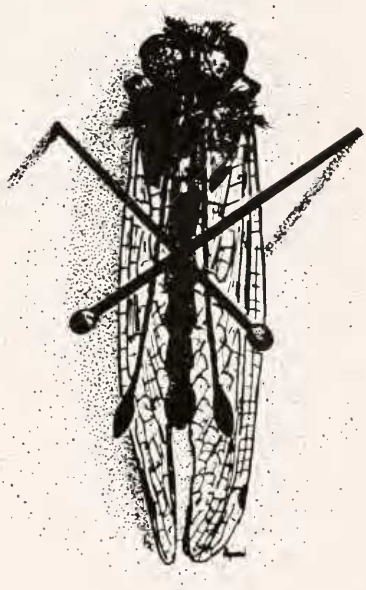

Fig. 3. Suggested method of mounting ascalaphids.

advantage since removal of the wax facilitates interpretation of veins which can aid in placing specimens to genus. Specimens in alcohol can be manipulated to allow examination of the hindwing and external genitalia of the male, which can sometimes be diagnostic without having to be cleared in KOH. This may prove unreliable unless one has experience with the group, but is time-saving if many specimens are to be examined. Females, for the most part, lack sclerotized structures (except in the *Aleuropteryx*) and cannot be determined to species unless associated with males.

There are a few lesser-known families of Neuroptera that are not often encountered by collectors. The Berothidae are similar to Hemerobiidae but can usually be pinned successfully with no. 1 pins. The shape, venation, and markings of the forewing along with internal genitalia are the most important characters. Spreading of wings is recommended since these insects are not usually common.

The Dilaridae are rare in collections, partially because they resemble small moths and are overlooked. The two Nearctic species of this group are easily separated by wing venation and geographic range. They are delicate insects and should be double-mounted.

Our few species of Polystoechotidae and Ithonidae are large and can be pinned without any problem. They all have distinctive forewings and spreading is unnecessary for determination.

Sometimes considered as part of the Neuroptera are the Megaloptera (Corydalidae and Sialidae) and the Raphidioptera (Raphidiidae and Inocelliidae. These insects should be pinned. It might be necessary to examine the hindwing of some Corydalidae to be able to work certain keys, but on the whole, no special procedures are needed. The genitalia remain the most important characters in making determinations, especially in Sialidae.

There are several exotic families not considered here. A basic rule is to pin or point everything except Coniopterygidae. If there are external genitalic structures, their view should be unobstructed by wings and if the forewing is not wholly transparent, some degree of spreading may be necessary to see hindwing characters. Also keep in mind the risk of breakage and conservation of space.

Genitalia Preparation

Accurate identification of most neuropterans to species often requires examination of genitalic structures, usually of the male. In some cases, the last few abdominal segments must be removed and treated in a 10% solution of KOH[4] to dissolve internal tissue and clear the abdominal wall

[4]Bram and Bickley (1963) used a 15% KOH solution to clear chrysopid genitalia (boiling for 13 minutes) while Meinander used a 5% solution for Coniopterygidae).

for examination of internal sclerotized structures. The time of treatment depends largely on size of the specimen and temperature of the solution. The clearing procedure will usually take about 24 hours in a room temperature solution (Tauber 1969). The smaller Coniopterygidae require less time, about 2-10 hours (Johnson 1980). A hot or boiling solution of KOH greatly reduces the time required for clearing. Dr. Phillip Adams (pers. comm.) recommends about 5 minutes for chrysopids. Martin (1977) recommended bringing the solution short of an actual boil to prevent possible damage. To eliminate this risk, a small beaker with KOH and genitalia can be placed inside a larger beaker of water. The water boils, heating the KOH without damaging setae.

After the abdomen has been cleared, it is usually desirable to flush out any remaining residue using a small (27 gauge) hypodermic syringe (Bram and Bickley (1963). After flushing, terminalia should be rinsed in distilled water. Sometimes structures may be everted for better viewing with a strong flush with a syringe (Tauber 1969) or with forceps for large forms such as myrmeleontids (Stange 1970).

Staining is often desirable in order to better discern the internal structures. Dr. Adams' method (pers. comm.) requires injecting the cleared abdomen with 5%[5] chlorazol black E aqueous solution and rinsing in distilled water. The specimen is placed in glycerine for viewing with glycerine being injected into the abdomen. A fine needle is used to apply the stain. For best results, the tip should be nicked, broken off square and the edges rounded with Arkansas stone.

Some workers mount genitalia on slides, but they should be preserved in glycerine-filled microvials (known as genitalia vials) and pinned with the specimen or placed in the vial of alcohol (silicone stoppers preferred). Mounting genitalia on slides does not allow manipulation to view dorsal or ventral aspects and they usually must be dissolved off slides for critical examination.

Female genitalia are not extensively used in most groups for species determinations. Usually structures are not sclerotized and while some are diagnostic, they are difficult to interpret. Structures such as spermatheca, copulatory bursa or subgenital plate have been used in some groups. Stange's 1970 revision of the brachynemurine ant-lions uses digging setae and posterior gonapophysis in the keys.

Larvae

Larvae of Nearctic species of Neuroptera are poorly known and represent a challenge for future workers. In some groups such as the Coniopterygidae, larvae of very few species have been described, while others such as Chrysopidae are better known.

[5]Some workers recommend a 1% solution to reduce the risk of overstaining, noting that destaining with Clorox® is possible, but hard on specimens.

Larval stages should be treated in KAAD (Peterson 1959) and preserved in 80-90% alcohol (ethyl or isopropyl). Dr. Catherine Tauber (pers. comm.) recommended treating chrysopids and hemerobiids for 20 minutes while Stange (1970) treated myrmeleontid larvae for about 24 hours. Henry (1976) discussed a method for clearing ascalaphid larvae for study.

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